JC17 Rec'd PCT/PTO 11 JUL 2001

FORM PTO-1390 (REV. 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER VO-542
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 C.F R. 1 5) 09/889099
INTERNATIONAL APPLICATION NO. PCT/EP00/00147	INTERNATIONAL FILING DATE 11 January 2000	PRIORITY DATE CLAIMED 11 January 1999

TITLE OF INVENTION

FLAT LIGHT SOURCE

APPLICANT(S) FOR DO/EO/US

Kurt NATTERMANN et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ■ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND OR SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ■ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ■ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ■ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ■ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ■ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ■ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ■ A substitute specification. (attached to a red-ink marked-up version of the English language translation)
15. ☐ A change of power of attorney and/or address letter.
16. ■ Other items or information:
    - Letter to Draftsperson with five (5) sheets of drawings with changes shown in red ink
    - Form PCT/IB/301
    - Form PCT/IB/304
    - Form PCT/IB/308
    - Form PCT/ISA/210 (English language version, 3 pages)
    - Transmittal of Substitute Specification
    - Certificate of Mailing by Express Mail (2 pages)
    - Return Receipt Postcard

EXPRESS MAIL NO.: EL688021494US
MAILED: 11 July 2001

JC18 Rec'd PCT/PTO 11 JUL 2001

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/889099	PCT/EP00/00147	VO-542

17. ■ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

Search Report has been prepared by the EPO or JPO .... $ 860.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) .... $ 690.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) .... $ 710.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... $ 1,000.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .... $ 100.00

CALCULATIONS — PTO USE ONLY

				CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ❑ 20 ❑ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).					
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	16* - 20 =	0	X $18.00		
Independent claims	2* - 03 =	0	X $80.00		
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00		
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).					
SUBTOTAL =				$ 860.00	
Processing fee of **$130.00** for furnishing the English translation later than ❑ 20 ❑ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +					
TOTAL NATIONAL FEE =				$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +					
TOTAL FEES ENCLOSED =				$ 860.00	
* Based upon entry of the First Preliminary Amendment.				Amount to be: refunded	$
				charged	$

a. ■ A check in the amount of $ 860.00 to cover the above fee is enclosed.

b. ☐ Please charge my Deposit Account No. ________ in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-3550. A duplicate copy of this sheet is enclosed.

NOTE: **Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

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Douglas H. Pauley

SIGNATURE

Douglas H. Pauley

NAME

33,295

REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Kurt NATTERMANN
Volker SEIBERT
Roland BÜRKLE
Reinhard KASSNER

Title: FLAT LIGHT SOURCE

Based Upon: PCT/EP00/00147

Express Mail No.: EL688021494US

Date of Deposit: 11 July 2001

FIRST PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please amend the subject application as follows to place this application in better condition for examination.

In the drawings, please amend Figs. 1-5, as discussed in the enclosed Letter to Draftsperson.

In the Claims, substitute the following Claims 1-11 (Amended) for the pending Claims 1-11 of the published International Application:

1. (Amended) In a large-area radiator with a front pane and a rear element, wherein spacer elements keep the front pane apart from the rear element, a gaseous filler is introduced into a space between the front pane and the rear element

and is at a lesser pressure than a pressure of a surrounding atmosphere, and the front pane is made of a glass material, the improvement comprising:

at least one of the front pane and the rear element at least partially of one of a thermally tempered glass pane and a chemically tempered glass pane.

2. (Amended) In the large-area radiator in accordance with claim 1, wherein a temperature at which a viscosity of the glass material of at least one of the front pane and the rear element is 13.6 dPas (TG temperature) is greater than 550°C.

3. (Amended) In the large-area radiator in accordance with claim 2, wherein at least one of a measurement of a wall thickness of at least one of the front pane and the back element is 1.5 mm to 2.1 mm, and a thermal tempering is greater than or equal to 60 Mpa.

4. (Amended) In the large-area radiator in accordance with claim 1, wherein at least one of a measurement of a wall thickness of at least one of the front pane and the back element is greater than 0.5 mm, and is tempered by a chemical tempering of more than 160 MPa.

5. (Amended) In a large-area radiator with a front pane and a rear element, wherein spacer elements keep the front pane apart from the rear element, a gaseous filler is introduced into a space between the front pane and the rear element and is at a lesser pressure than a pressure of a surrounding atmosphere, and the front pane is made of a glass material, the improvement comprising:

at least one of the front pane and the rear element each embodied as a glass pane which at least partially has a coating of a ductile polymer material.

6. (Amended) In the large-area radiator in accordance with claim 5, wherein the coating is a film of a silicon, a polyurethane and a polymer material, selected from a group of ormoceres.

7. (Amended) In the large-area radiator in accordance with claim 6, wherein the coating has a thickness of more than 6 µm.

8. (Amended) In the large-area radiator in accordance with claim 7, wherein the thickness of the coating is within a range of 6 µm and 50 µm.

9. (Amended) In the large-area structure in accordance with claim 8, wherein a primer is used for bonding the coating to a surface of the glass pane, and the primer is one of a dimethoxydimethyl silane and a hexamethyl disilazane.

10. (Amended) In the large-area radiator in accordance with claim 9, wherein the glass pane is at least partially tempered one of thermally and chemically.

11. (Amended) In the large-area radiator in accordance with claim 10, wherein the spacer elements are wavy and are arranged between the front pane and the rear element, wherein a wavy line extends generally parallel with a planar extension of the front pane.

Please add the following new claims:

12. In the large-area radiator in accordance with claim 5, wherein the coating has a thickness of more than 6 μm.

13. In the large-area structure in accordance with claim 5, wherein a primer is used for bonding the coating to a surface of the glass pane, and the primer is one of a dimethoxydimethyl silane and a hexamethyl disilazane.

14. In the large-area radiator in accordance with claim 5, wherein the glass pane is at least partially tempered one of thermally and chemically.

15. In the large-area radiator in accordance with claim 1, wherein the spacer elements are wavy and are arranged between the front pane and the rear element, wherein a wavy line extends generally parallel with a planar extension of the front pane.

16. In the large-area radiator in accordance with claim 1, wherein at least one of a measurement of a wall thickness of at least one of the front pane and the back element is 1.5 mm to 2.1 mm, and a thermal tempering is greater than or equal to 60 Mpa.

On a separate page, please add the following: **ABSTRACT OF THE DISCLOSURE.**

Based Upon: PCT/EP00/00147

--ABSTRACT OF THE DISCLOSURE

A flat light source having a front plate and a rear part. The front plate is held at a distance from the rear part by spacers. A gaseous filling which is under a pressure lower than the ambient atmospheric pressure is introduced into the intermediate space between the front plate and rear part, and the front plate is of a glass material. To be able to produce flat light sources of this type which have a low intrinsic weight, according to this invention the front plate and/or the rear part can be configured as an at least partly thermally or chemically tempered glass pane or the front plate and/or the rear part can be configured as a glass pane which at least in areas is coated with a ductile polymer material.--

Based Upon: PCT/EP00/00147

REMARKS

Applicants respectfully request entry of the above Preliminary Amendment to place this Patent Application in better form for examination and prosecution before the U.S. Patent and Trademark Office.

The claims have been amended to eliminate multiple dependent claims and to more definitely and fully claim the subject matter of Applicants' invention. The drawings have been amended to add figure numbers. Applicants urge that the above Preliminary Amendment introduces no new matter into this Patent Application.

Applicants sincerely believe that this Patent Application is now in condition for examination and prosecution before the U.S. Patent and Trademark Office.

Respectfully submitted,

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Based Upon: PCT/EP00/00147

VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) In a [A] large-area radiator with a front pane and a rear element, wherein spacer elements keep the front pane [is kept] apart from the rear element [by means of spacer elements], [wherein] a gaseous filler [has been] is introduced into [the] a space between the front pane and the rear element and is at a lesser pressure than [the] a pressure of [the] a surrounding atmosphere, and [wherein] the front pane is made of a glass material, the improvement comprising:

[characterized in that]

at least one of the front pane [and/or] and the rear element [are embodied as] at least partially of one of a thermally [or] tempered glass pane and a chemically tempered glass [panes] pane.

2. (Amended) In the [The] large-area radiator in accordance with claim 1, wherein a

[characterized in that

the] temperature[,] at which [the] a viscosity of the glass material of at least one of the [thermally tempered] front pane [and/or] and the rear element is 13.6 dPas (TG temperature)[,] is greater than 550°C.

3. (Amended) In the [The] large-area radiator in accordance with claim [1 or] 2, wherein at least one of a

[characterized in that

the] measurement of [the] a wall thickness of at least one of the [thermally tempered] front pane [and/or] and the back element is 1.5 mm to 2.1 mm, [and/or the] and a thermal tempering is greater than or equal to 60 Mpa.

4. (Amended) In the [The] large-area radiator in accordance with claim 1, wherein at least one of a

[characterized in that

the] measurement of [the] a wall thickness of at least one of the [thermally tempered] front pane [and/or] and the back element is greater than 0.5 mm, [and/or] and is tempered by [means of] a chemical tempering of more than 160 MPa.

5. (Amended) In a [A] large-area radiator with a front pane and a rear element, wherein spacer elements keep the front pane [is kept] apart from the rear element [by means of spacer elements], [wherein] a gaseous filler [has been] is introduced into [the] a space between the front pane and the rear element and is at a

lesser pressure than [the] a pressure of [the] a surrounding atmosphere, and [wherein] the front pane is made of a glass material, the improvement comprising:

[characterized in that]

at least one of the front pane [and/or] and the rear element each [are] embodied as a glass [panes] pane which [are] at least partially [provided with] has a coating [consisting] of a ductile polymer material.

6. (Amended) In the [The] large-area radiator in accordance with claim 5, wherein

[characterized in that]

the coating is [embodied as] a film [and consists] of a silicon, a polyurethane [or] and a polymer material, selected from [the] a group of [the] ormoceres.

7. (Amended) In the [The] large-area radiator in accordance with claim [5 or] 6, wherein

[characterized in that]

the coating has a thickness of more than 6 µm.

8. (Amended) In the [The] large-area radiator in accordance with claim 7, wherein

[characterized in that]

the thickness of the coating [lies] is within [the] a range of 6 μm and 50 μm.

9. (Amended) In the [The] large-area structure in accordance with [one of claims 5 to] claim 8, wherein

[characterized in that]

a primer is used for bonding the coating to [the] a surface of the glass pane, [preferably] and the primer is one of a dimethoxydimethyl silane [or] and a hexamethyl disilazane.

10. (Amended) In the [The] large-area radiator in accordance with [one of claims 5 to] claim 9, wherein

[characterized in that]

the glass pane is at least partially tempered one of thermally [or] and chemically [tempered].

11. (Amended) In the [The] large-area radiator in accordance with [one of claims 1 to] claim 10, wherein the

[characterized in that

wavy] spacer elements are wavy and are arranged between the front pane and the rear element, [which is also embodied as a glass pane,] wherein [the] a wavy line extends generally parallel with [the] a planar extension of the front pane.

Based Upon: PCT/EP00/00147

SUBSTITUTE SPECIFICATION

Based Upon: PCT/EP00/00147

FLAT LIGHT SOURCE

Based Upon: PCT/EP00/00147

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a large-area radiator with a front pane and a rear element, wherein the front pane is kept apart from the rear element by spacer elements, a gaseous filler is introduced into the space between the front pane and the rear element and is at a lesser pressure than the pressure of the surrounding atmosphere, and the front pane is made of a glass material.

Description of Related Art

Transmissive LCDs require background illumination by a strong light of homogeneous luminance, reduced thickness, low rate of breakage during assembly and handling, and with a great strength over time. Gas discharge lamps with a filling of a noble gas at underpressure meet the requirements of homogeneous luminance and low heat emission. These lamps can also be designed as large-area radiators.

The main mechanical components of such large-area radiators are the front and rear pane and spacer elements for keeping the front and rear panes apart. Front and rear panes made of glass are preferred. It is known to provide rear panes made of glass with reflecting coatings, or foils.

Large-area radiators are known, wherein the discharge current flows through "folded" channels between the front and rear panes, which requires an operating voltage of several hundred Volts (Company Publication "Flat Candle Backlight Products for 4" Diagonal LCD"). Large-area radiators are also known, in

which the current flows directly from the rear to the front pane. Such large-area radiators are operated in connection with LCD applications with operating voltages of only approximately 10 V.

A considerable disadvantage of large-area radiators with an underpressure filling is the great thickness and large weight. The thickness is the result of the minimum discharge distance and of the thickness of the glass panes for the front and rear panes. The pane thickness is the result of strength requirements.

Large-area radiators with front and rear panes of approximately 2.5 mm thickness, which are maintained at an essentially even distance of 40 to 50 mm by spacer elements, are known. Fig. 1 shows a section in a perspective view, taken through a known large-area radiator, in which the front and rear pane and parallel, continuous, strip-shaped spacer elements are shown. It is known that when employing thinner glass panes for the front and rear pane, for example for weight-saving or for reducing the thickness of the large-area radiator, the following problems occur: too large mechanical stresses in the panes; too great bending of the panes between spacer elements; and buckling, tipping over or tearing off of the spacer elements.

The mechanical stresses in the panes because of the exterior pressure are considered to be a main problem. The tensile stress at the exterior surfaces of the pane is on a scale of approximately σ x $a(w/t)^2$, wherein t identifies the pane thickness and w the distance between the spacer elements. When the pane thickness is reduced, it is also necessary to reduce the distance between the spacer elements. It is assumed

that with a pane thickness t = 2.5 mm, a distance between the spacer elements of at least w = 40 to 50 mm is required to keep the tensile stress at the exterior surface of the panes below approximately 10 MPa (expected fatigue strength of class). At a pane thickness of 1 mm, a distance between the spacer elements of less than 20 mm would therefore be required. This results in an increased production outlay and a reduction of the light yield because of the many spacer elements. This assumption has prevented the production of large-area radiators with thinner front and rear panes, or with a greater distance between the spacer elements.

SUMMARY OF THE INVENTION

It is one object of this invention to achieve a weight reduction of a large-area radiator of the type mentioned above.

This object of this invention is attained with a front pane and/or a rear pane that are embodied as glass panes, which are at least partially thermally or chemically tempered.

With thermally or chemically tempered glass panes it is possible to achieve considerably greater spacer element distances than with known large-area radiators. Table 1 shows what maximum distance can be obtained for the spacer elements w as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 1

	without coating		with coating	
t(mm)	w (mm)	σ_{v1min} (Mpa)	W_{max}(mm)	σ_{v1min} (MPa)
2.1	105	120	120	120
1.9	85	100	100	100
1.7	68	80	82	80
1.5	52	60	65	60

Tempering of more than 100 MPa in thin glass panes can only be achieved with high-stress glass (thermal expansion coefficient $_{\sigma 20,300} > 7 \times 10^{-6}$ 1/°C) or with glass with a high T_G ($T_G > 550$°C; where T_G is the temperature at which the viscosity of the glass is $10^{13.6}$dPa). The use of glass with a high T_G has a further advantage that it is possible to subject the large-area radiators to high temperatures during the manufacturing process. Therefore glass with a high T_G is preferred. But the thermal tempering of thin glass panes is still very expensive.

For panes with low stress, or for panes of a thickness of less than 1.5 mm, thermal tempering shows hardly positive effects. Therefore chemical tempering with known methods is preferred.

The combination of chemical tempering and coating with ductile polymer layers here leads to a further increase in strength. Coating must be performed after tempering.

With chemically tempered glass it is possible to achieve considerably greater distances between the spacer elements than with the known large-area radiators, along with a sufficient strength of the large-area radiators. Table 2 shows the distance w between spacer elements which can be achieved as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 2

	without coating		with coating	
t(mm)	w (mm)	σ_{v1min} (MPa)	W_{max}(mm)	σ_{v1min} (MPa)
1.5	95	200	105	200
1.3	81	200	89	200
1.1	70	200	76	200
0.9	55	200	61	200
0.7	42	180	46	180
0.5	28	160	32	160

It was found that the strength of the large-area radiators can be considerably increased if the stability under load of the spacer elements is increased by using wavy spacer elements instead of straight spacer elements.

An object of this invention is also achieved with the front pane and/or the rear element embodied as glass panes, which at least partially have a coating of a ductile polymer material.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of this invention are better understood when this specification is read in view of the drawings, wherein:

Fig. 1 is a sectional perspective view of a large-area radiator having parallel strip-shaped spacer elements;

Fig. 2 is a schematic top view and partial sectional view of a large-area radiator having parallel strip-shaped spacer elements;

Fig. 3 is a schematic top view and partial sectional view of a large-area radiator having segmented spacer elements;

Fig. 4 is a schematic top view and partial sectional view of a large-area radiator having spot spacer elements; and

Fig. 5 is a schematic top view and partial sectional view of a large-area radiator having wavy spacer elements.

DESCRIPTION OF PREFERRED EMBODIMENTS

Large-area radiators with a rectangular base and of an even thickness are used to describe this invention, however, the teaching in accordance with this invention can also be applied to other shapes of large-area radiators. Therefore those are made a part of this invention.

Parallel, strip-like spacer elements, which continuously extend parallel with an edge of the large-area radiator (Fig. 2), are used to describe this invention. However, the teaching in accordance with this invention can also be applied to any

other designs, in particular segmented spacer elements (Fig. 3), and spot spacer elements (Fig. 4), or wavy spacer elements (Fig. 5), which are a part of this invention.

It was discovered that a sufficient strength of large-area radiators could also be achieved with front and rear panes of glass of a thickness of less than 2.5 mm, if the glass panes are laminated with plastic coatings.

Tests have shown that with laminating the exterior of the glass panes, used as front and rear panes, with thin, ductile polymer films, a sufficient surface strength of the large-area radiators is achieved. Suitable for this are thin coatings of silicon, polyurethane or polymers from the group of ormoceres. Because of their high temperature resistance (up to 200°C) and great resistance to many organic solvents and aqueous solutions, silicon coatings are preferred.

The polymer films already become effective at coating thicknesses starting at approximately 6 μm. The stability increasing effects of the coatings basically increase with increasing thickness. However, starting at a thickness of 50 μm this increase is no longer significant. The thickness range between 6 to 50 μm is preferred, because then the elasticity of the bond is little reduced and the shrinkage of the polymer films leads to only small stresses in the glass panes. However, the application of thicker coatings up to approximately 200 μm can be useful for manufacturing reasons.

It is possible to employ primers for improving the adherence of the mainly homopolar polymers on the polar glass surface which, by a reactive bond of

OH groups on the glass surface with their homopolar side chains, provide a homopolar glass surface with good adhesive properties for homopolar organic polymers. Dimethoxydimethyx silane or hexamethyl disilazane, for example, are suitable primers.

The stability-increasing effect of the polymer coatings actually is a stability conservation. The coatings prevent the creation of stability-reducing micro-defects in the surface of the glass panes during transport, assembly or handling of the glass panes. This effect therefore is particularly developed when the coatings are applied early, preferably immediately following the drawing of the glass panes, and even more preferred prior to cutting the glass panes, for example for fabricating the panes in the size of large-area radiators.

With the above described glass panes it is possible to achieve considerably greater distances between spacer elements than with the known large-area radiators, without their strength being reduced. Table 3 shows, by way of example, which distances w between spacer elements can be achieved as a function of the pane thickness t.

Table 3

t (mm)	w (mm)
2.1	75
1.9	65
1.7	54
1.5	48
1.3	37
1.1	31
0.9	25
0.7	20

An advantageous variation can result if the polymer coating is applied at a temperature above the operating temperature of the large-area radiator. With this the polymer coating on the pane is under permanent compressive strain and is therefore scratch-proof.

Coatings with polymers have one disadvantage that the coated glass panes may not be exposed to high temperatures during subsequent thermal treatment. The temperature must remain clearly below 200°C as a rule. This limitation is unacceptable if, for example, the panes must be soldered while mounting the large-area radiator, or if gettering must be performed on mounted large-area radiators.

In this case, the panes can be advantageously sealed with a removable protective film immediately following their production. This temporary protective film is washed off prior to the respective temperature treatment. Thereafter, another temporary sealing takes place, if required, or there is the immediate application of the permanent coatings in accordance with this invention.

Tests show that it is possible to create a thermal tempering of panes starting from a thickness of 1.5 mm by strongly blowing cold air against them or dipping them into oil, or oil-covered water, which considerably increases the stability of the large-area radiators. Thermal tempering should take place after cutting the glass panes, for example for fabricating the panes in the size of large-area radiators.

The combination of thermal tempering and coating with ductile polymer layers results in a further increase of stability. Coating must occur after tempering.

This invention is explained in greater detail in view of two embodiments:

Embodiment 1

The rear pane of a large-area radiator, which itself is finished and capable of functioning, is sprayed with a thin coat of a two-component silicon polymer after the last baking process, so that a continuous wetting layer is created. The layer is then polymerized. The amount of silicon polymer is set so that a polymer coating of 40 to 45 μm thickness results.

Embodiment 2

A large-area radiator of 320 x 360 mm size is to be provided with a chemically tempered front pane of 1.1 mm thickness. Glass D263, for example DESAG AG of Grünenplan, is used for the front pane. 1.1 mm thick panes made of this glass are dipped for 16 h in a hot KNO_3 bath at 450°C in order to temper them by the "Na - K exchange". By means of this, tempering of more than 230 MPa is created in a surface layer to a depth of 80 μm. It was observed that, in the subsequent processes in the course of producing the large-area radiator, a portion of the tempering was "washed out" again, but tempering of more than 200 MPa was observed to be a permanent value.

Flat Light Source

BACKGROUND OF THE INVENTION

Field of the Invention

[The] This invention relates to a large-area radiator with a front pane and a rear element, wherein the front pane is kept apart from the rear element by [means of] spacer elements, [wherein] a gaseous filler [has been] is introduced into the space between the front pane and the rear element and is at a lesser pressure than the pressure of the surrounding atmosphere, and [wherein] the front pane is made of a glass material.

Description of Related Art

Transmissive LCDs require background illumination by a strong light of homogeneous luminance, reduced thickness, low rate of breakage during assembly and handling, and with a great strength over time. Gas discharge lamps with a filling of a noble gas at underpressure meet the requirements of homogeneous luminance and low heat emission. These lamps can also be designed as large-area radiators.

The [essential] main mechanical components of such large-area radiators are the front and rear pane and spacer elements for keeping the front and rear panes apart. Front and rear panes made of glass are preferred. It is known to provide rear panes made of glass with reflecting coatings, or foils.

Large-area radiators are known in the prior art, wherein the discharge current flows through "folded" channels between the front and rear panes, which requires an operating voltage of

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several hundred Volts (Company Publication "Flat Candle Backlight Products for 4" Diagonal LCD"). Large-area radiators are also known, in which the current flows directly from the rear to the front pane. Such large-area radiators are operated in connection with LCD applications with operating voltages of only approximately 10 V.

A considerable disadvantage of large-area radiators with an underpressure filling is the great thickness and large weight. The thickness is the result of the minimum discharge distance and of the thickness of the glass panes for the front and rear panes. The pane thickness is the result of strength requirements.

Large-area radiators with front and rear panes of approximately 2.5 mm thickness, which are maintained at an essentially even distance of 40 to 50 mm by spacer elements, [represent the prior art] are known. Fig. 1 shows a section in a perspective view, taken through a known large-area radiator, in which the front and rear pane and parallel, continuous, strip-shaped spacer elements are shown [can be seen]. It [has been shown] is known that when employing thinner glass panes for the front and rear pane, for example for weight-saving or for reducing the thickness of the large-area radiator, the following problems occur:

[■] too large mechanical stresses in the panes[.];

■ too great bending of the panes between spacer elements; ; and

■ buckling, tipping over or tearing off of the spacer elements.

The mechanical stresses in the panes because of the exterior pressure are considered to be an essential a main problem. The tensile stress at the exterior surfaces of the pane is on a scale of approximately σ x a(w/t)^2, wherein t identifies the pane thickness and w the distance between the spacer elements. It can be seen that when When the pane thickness is reduced, it is also necessary to reduce the distance between the spacer elements. It is assumed that with a pane thickness t = 2.5 mm, a distance between the spacer elements of at least w = 40 to 50 mm is required to keep the tensile stress at the exterior surface of the panes below approximately 10 MPa (expected fatigue strength of class). At a pane thickness of 1 mm, a distance between the spacer elements of less than 20 mm would therefore be required. This results in an increased production outlay and a reduction of the light yield because of the many spacer elements. This assumption has up to now prevented the production of large-area radiators with thinner front and rear panes, or with a greater distance between the spacer elements.

SUMMARY OF THE INVENTION

It is ~~the~~ one object of ~~the~~ this invention to achieve a weight reduction of a large-area radiator of the type mentioned ~~at the outset~~ above.

This object of ~~the~~ this invention is attained ~~in that the~~ with a front pane and/or ~~the~~ a rear pane that are embodied as glass panes, which are at least partially thermally or chemically tempered.

~~By means of~~ With thermally or chemically tempered glass panes it is possible to achieve considerably greater spacer element distances than with known large-area radiators. Table 1 shows what maximum distance can be obtained for the spacer elements w as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 1

	without coating		with coating	
t(mm)	w (mm)	σ_{v1min} (Mpa)	W_{max}(mm)	σ_{v1min} (MPa)
2.1	105	120	120	120
1.9	85	100	100	100
1.7	68	80	82	80
1.5	52	60	65	60

Tempering of more than 100 MPa in thin glass panes can only be achieved with high-stress glass (thermal expansion coefficient $_{\sigma 20,300} > 7 \times 10^{-6}$ 1/°C) or with glass with a high T_G (T_G >

550°C; where T_G is the temperature at which the viscosity of the glass is $10^{13.6}$dPa). The use of glass with a high T_G has ~~the~~ a further advantage that it is ~~then~~ possible to subject the large-area radiators to high temperatures during the manufacturing process. Therefore glass with a high ~~T^G~~ T_G is preferred. But the thermal tempering of thin glass panes is still very expensive.

For panes with low stress, or for panes of a thickness of less than 1.5 mm, thermal tempering shows hardly positive effects. Therefore chemical tempering ~~by means of the~~ with known methods ~~known per se~~ is preferred.

The combination of chemical tempering and coating with ductile polymer layers here leads to a further increase in strength. Coating must be performed after tempering.

With chemically tempered glass it is possible to achieve considerably greater distances between the spacer elements than with the known large-area radiators, along with a sufficient strength of the large-area radiators. Table 2 shows the distance w between spacer elements which can be achieved as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 2

without coating with coating

t(mm)	w (mm)	σ_{v1min} (MPa)	W_{max}(mm)	σ_{v1min} (MPa)
1.5	95	200	105	200
1.3	81	200	89	200
1.1	70	200	76	200
0.9	55	200	61	200
0.7	42	180	46	180
0.5	28	160	32	160

It was found that the strength of the large-area radiators can be considerably increased if the stability under load of the spacer elements is increased by using wavy spacer elements instead of straight spacer elements.

An this achieved with

The object of the invention is also attained in that the front pane and/or the rear

have

element are embodied as glass panes, which are at least partially provided with a coating consisting of a ductile polymer material.

DESCRIPTION OF PREFERRED EMBODIMENTS

an

Large-area radiators with a rectangular base and of even thickness are made the basis

used to describe this

for describing the invention, however, the teaching in accordance with this invention can also be

this

applied to other shapes of large-area radiators. Therefore those are made a part of the invention.

Parallel, strip-like spacer elements, which continuously extend parallel with an edge

(Fig. 2) used to describe this

of the large-area radiator, are made the basis for describing the invention. However, the teaching in

insert from pg. 7A

BRIEF DESCRIPTION OF THE DRAWINGS

The features of this invention are better understood when this specification is read in view of the drawings, wherein:

Fig. 1 is a sectional perspective view of a large-area radiator having parallel strip-shaped spacer elements;

Fig. 2 is a schematic top view and partial sectional view of a large-area radiator having parallel strip-shaped spacer elements;

Fig. 3 is a schematic top view and partial sectional view of a large-area radiator having segmented spacer elements;

Fig. 4 is a schematic top view and partial sectional view of a large-area radiator having spot spacer elements; and

Fig. 5 is a schematic top view and partial sectional view of a large-area radiator having wavy spacer elements.

accordance with this invention can also be applied to any other designs, in particular segmented spacer elements (Fig. 3), and spot spacer elements (Fig. 4), or wavy spacer elements (Fig. 5).

, which this

Therefore those are made a part of the invention.

It was discovered that a sufficient strength of large-area radiators could also be achieved with front and rear panes of glass of a thickness of less than 2.5 mm, if the glass panes are laminated with plastic coatings.

with

Tests have shown that by means of laminating the exterior of the glass panes used as front and rear panes with thin, ductile polymer films a sufficient surface strength of the large-area radiators is achieved. Suitable for this are thin coatings of silicon, polyurethane or polymers from the group of ormoceres. Because of their high temperature resistance (up to 200°C) and great resistance to many organic solvents and aqueous solutions, silicon coatings are preferred.

The polymer films already become effective at coating thicknesses starting at approximately 6 µm. The stability-increasing effects of the coatings basically increase with increasing thickness. However, starting at a thickness of 50 µm this increase is no longer significant. The thickness range between 6 to 50 µm is preferred, because then the elasticity of the bond is little reduced and the shrinkage of the polymer films leads to only small stresses in the glass panes.

However, the application of thicker coatings up to approximately 200 μm can be useful for manufacturing reasons.

It is additionally possible to employ primers for improving the adherence of the mainly homopolar polymers on the polar glass surface which, by a reactive bond of OH groups on the glass surface with their homopolar side chains, provide a homopolar glass surface with good adhesive properties for homopolar organic polymers. Dimethoxydimethyx silane or hexamethyl disilazane, for example, are suitable primers.

The stability-increasing effect of the polymer coatings actually is a stability conservation. The coatings prevent the creation of stability-reducing micro-defects in the surface of the glass panes during transport, assembly or handling of the glass panes. This effect therefore is particularly developed when the coatings are applied early, preferably immediately following the drawing of the glass panes, and even more preferred prior to cutting the glass panes, (for example for fabricating the panes in the size of large-area radiators).

With

By means of the above described glass panes it is possible to achieve considerably greater distances between spacer elements than with the known large-area radiators, without their

which

strength being reduced. Table 3 shows, by way of example, what distances w between spacer elements can be achieved as a function of the pane thickness t.

Table 3

t (mm)	w (mm)
2.1	75
1.9	65
1.7	54
1.5	48
1.3	37
1.1	31
0.9	25
0.7	20

An advantageous variation can result if the polymer coating is applied at a temperature which lies above the operating temperature of the large-area radiator. By means of, with this it is achieved that the polymer coating on the pane is under permanent compressive strain and is therefore scratch-proof.

one

Coatings with polymers have the disadvantage that the coated glass panes may not be exposed to high temperatures in the course of, during subsequent thermal treatment. The temperature must remain clearly below 200°C as a rule. This limitation is unacceptable if, for example, the

panes must be soldered in the course of while mounting the large-area radiator, or if gettering must be performed on mounted large-area radiators.

In this case, it is possible to make use of the advantages of the invention by sealing the panes can be advantageously sealed with a removable protective film immediately following their production. This temporary protective film is washed off prior to the respective temperature treatment. Thereafter, another temporary sealing takes place, if required, or there is the immediate application of the permanent coatings in accordance with the this invention.

Tests show that it is possible to create a thermal tempering of panes starting from a thickness of 1.5 mm by strongly blowing cold air against them or dipping them into oil, or oil-covered water, which considerably increases the stability of the large-area radiators. Thermal tempering should take place after cutting the glass panes, (for example for fabricating the panes in the size of large-area radiators).

The combination of thermal tempering and coating with ductile polymer layers results in a further increase of stability. Coating must take place occur after tempering.

The This invention will be is explained in greater detail in what follows by means view of two exemplary embodiments:

~~Exemplary~~ Embodiment 1

The rear pane of a large-area radiator, which itself is ~~already~~ finished and capable of functioning, is sprayed with a thin coat of a two-component silicon polymer after the last baking process, so that a continuous wetting layer is created. The layer is then polymerized. The amount of silicon polymer is set ~~in such a way~~ so that a polymer coating of 40 to 45 μm thickness results.

~~Exemplary~~ Embodiment 2

A large-area radiator of 320 x 360 mm size is to be provided with a chemically tempered front pane of 1.1 mm thickness. Glass D263 ~~(reference:~~ , for example DESAG AG of Grünenplan ~~)~~ , is used for the front pane. 1.1 mm thick panes made of this glass are dipped for 16 h in a hot KNO_3 bath at 450°C in order to temper them by the "Na - K exchange". By means of this, tempering of more than 230 MPa is created in a surface layer to a depth of 80 μm. It was observed that, in the subsequent processes in the course of producing the large-area radiator, a portion of the tempering was "washed out" again, but tempering of more than 200 MPa was observed to be a permanent value.

Flat Light Source

The invention relates to a large-area radiator with a front pane and a rear element, wherein the front pane is kept apart from the rear element by means of spacer elements, wherein a gaseous filler has been introduced into the space between the front pane and the rear element and is at a lesser pressure than the pressure of the surrounding atmosphere, and wherein the front pane is made of a glass material.

Transmissive LCDs require background illumination by a strong light of homogeneous luminance, reduced thickness, low rate of breakage during assembly and handling, and with a great strength over time. Gas discharge lamps with a filling of a noble gas at underpressure meet the requirements of homogeneous luminance and low heat emission. These lamps can also be designed as large-area radiators.

The essential mechanical components of such large-area radiators are the front and rear pane and spacer elements for keeping the front and rear panes apart. Front and rear panes made of glass are preferred. It is known to provide rear panes made of glass with reflecting coatings, or foils.

Large-area radiators are known in the prior art, wherein the discharge current flows through "folded" channels between the front and rear panes, which requires an operating voltage of

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several hundred Volts (Company Publication "Flat Candle Backlight Products for 4" Diagonal LCD"). Large-area radiators are also known, in which the current flows directly from the rear to the front pane. Such large-area radiators are operated in connection with LCD applications with operating voltages of only approximately 10 V.

A considerable disadvantage of large-area radiators with an underpressure filling is the great thickness and large weight. The thickness is the result of the minimum discharge distance and of the thickness of the glass panes for the front and rear panes. The pane thickness is the result of strength requirements.

Large-area radiators with front and rear panes of approximately 2.5 mm thickness, which are maintained at an essentially even distance of 40 to 50 mm by spacer elements, represent the prior art. Fig. 1 shows a section in a perspective view through a known large-area radiator, in which the front and rear pane and parallel, continuous, strip-shaped spacer elements can be seen. It has been shown that when employing thinner glass panes for the front and rear pane, for example for weight-saving or for reducing the thickness of the large-area radiator, the following problems occur:

- too large mechanical stresses in the panes,

- too great bending of the panes between spacer elements,

- buckling, tipping over or tearing off of the spacer elements.

The mechanical stresses in the panes because of the exterior pressure are considered to be an essential problem. The tensile stress at the exterior surfaces of the pane is on a scale of approximately σ x $a(w/t)^2$, wherein t identifies the pane thickness and w the distance between the spacer elements. It can be seen that when the pane thickness is reduced, it is also necessary to reduce the distance between the spacer elements. It is assumed that with a pane thickness t = 2.5 mm, a distance between the spacer elements of at least w = 40 to 50 mm is required to keep the tensile stress at the exterior surface of the panes below approximately 10 MPa (expected fatigue strength of class). At a pane thickness of 1 mm, a distance between the spacer elements of less than 20 mm would therefore be required. This results in an increased production outlay and a reduction of the light yield because of the many spacer elements. This assumption has up to now prevented the production of large-area radiators with thinner front and rear panes, or with a greater distance between the spacer elements.

It is the object of the invention to achieve a weight reduction of a large-area radiator of the type mentioned at the outset.

This object of the invention is attained in that the front pane and/or the rear pane are embodied as glass panes, which are at least partially thermally or chemically tempered.

By means of thermally or chemically tempered glass panes it is possible to achieve considerably greater spacer element distances than with known large-area radiators. Table 1 shows what maximum distance can be obtained for the spacer elements w as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 1

	without coating		with coating	
t(mm)	w (mm)	σ_{v1min} (Mpa)	W_{max}(mm)	σ_{v1min} (MPa)
2.1	105	120	120	120
1.9	85	100	100	100
1.7	68	80	82	80
1.5	52	60	65	60

Tempering of more than 100 MPa in thin glass panes can only be achieved with high-stress glass (thermal expansion coefficient $_{\sigma 20,300} > 7 \times 10^{-6}$ 1/°C) or with glass with a high T_G (T_G >

550 °C; T_G is the temperature at which the viscosity of the glass is $10^{13.6}$dPa). The use of glass with a high T_G has the further advantage that it is then possible to subject the large-area radiators to high temperatures during the manufacturing process. Therefore glass with a high T^G is preferred. But the thermal tempering of thin glass panes is still very expensive.

For panes with low stress, or for panes of a thickness of less than 1.5 mm, thermal tempering shows hardly positive effects. Therefore chemical tempering by means of the methods known per se is preferred.

The combination of chemical tempering and coating with ductile polymer layers here leads to a further increase in strength. Coating must be performed after tempering.

With chemically tempered glass it is possible to achieve considerably greater distances between the spacer elements than with the known large-area radiators, along with a sufficient strength of the large-area radiators. Table 2 shows the distance w between spacer elements which can be achieved as a function of the pane thickness t, and what surface pressure tempering must be achieved in the glass panes at least (σ_{v1min}).

Table 2

without coating with coating

t(mm)	w (mm)	σ_{v1min} (MPa)	W_{max}(mm)	σ_{v1min} (MPa)
1.5	95	200	105	200
1.3	81	200	89	200
1.1	70	200	76	200
0.9	55	200	61	200
0.7	42	180	46	180
0.5	28	160	32	160

It was found that the strength of the large-area radiators can be considerably increased if the stability under load of the spacer elements is increased by using wavy spacer elements instead of straight spacer elements.

The object of the invention is also attained in that the front pane and/or the rear element are embodied as glass panes, which are at least partially provided with a coating consisting of a ductile polymer material.

Large-area radiators with a rectangular base and of even thickness are made the basis for describing the invention, however, the teaching in accordance with this invention can also be applied to other shapes of large-area radiators. Therefore those are made a part of the invention.

Parallel, strip-like spacer elements, which continuously extend parallel with an edge of the large-area radiator, are made the basis for describing the invention. However, the teaching in

accordance with this invention can also be applied to any other designs, in particular segmented spacer elements (Fig. 3), and spot spacer elements (Fig. 4), or wavy spacer elements (Fig. 5). Therefore those are made a part of the invention.

It was discovered that a sufficient strength of large-area radiators could also be achieved with front and rear panes of glass of a thickness of less than 2.5 mm, if the glass panes are laminated with plastic coatings.

Tests have shown that by means of laminating the exterior of the glass panes used as front and rear panes with thin, ductile polymer films a sufficient surface strength of the large-area radiators is achieved. Suitable for this are thin coatings of silicon, polyurethane or polymers from the group of ormoceres. Because of their high temperature resistance (up to 200°C) and great resistance to many organic solvents and aqueous solutions, silicon coatings are preferred.

The polymer films already become effective at coating thicknesses starting at approximately 6 μm. The stability- increasing effects of the coatings basically increase with increasing thickness. However, starting at a thickness of 50 μm this increase is no longer significant. The thickness range between 6 to 50 μm is preferred, because then the elasticity of the bond is little reduced and the shrinkage of the polymer films leads to only small stresses in the glass panes.

However, the application of thicker coatings up to approximately 200 μm can be useful for manufacturing reasons.

It is additionally possible to employ primers for improving the adherence of the mainly homopolar polymers on the polar glass surface which, by a reactive bond of OH groups on the glass surface with their homopolar side chains, provide a homopolar glass surface with good adhesive properties for homopolar organic polymers. Dimethoxydimethyx silane or hexamethyl disilazane, for example, are suitable primers.

The stability-increasing effect of the polymer coatings actually is a stability conservation. The coatings prevent the creation of stability-reducing micro-defects in the surface of the glass panes during transport, assembly or handling of the glass panes. This effect therefore is particularly developed when the coatings are applied early, preferably immediately following the drawing of the glass panes, and even more preferred prior to cutting the glass panes (for example for fabricating the panes in the size of large-area radiators).

By means of the above described glass panes it is possible to achieve considerably greater distances between spacer elements than with the known large-area radiators, without their

strength being reduced. Table 3 shows by way of example what distances w between spacer elements can be achieved as a function of the pane thickness t.

Table 3

t (mm)	w (mm)
2.1	75
1.9	65
1.7	54
1.5	48
1.3	37
1.1	31
0.9	25
0.7	20

An advantageous variation can result if the polymer coating is applied at a temperature which lies above the operating temperature of the large-area radiator. By means of this it is achieved that the polymer coating on the pane is under permanent compressive strain and is therefore scratch-proof.

Coatings with polymers have the disadvantage that the coated glass panes may not be exposed to high temperatures in the course of subsequent thermal treatment. The temperature must remain clearly below 200°C as a rule. This limitation is unacceptable if, for example, the

panes must be soldered in the course of mounting the large-area radiator, or if gettering must be performed on mounted large-area radiators.

In this case it is possible to make use of the advantages of the invention by sealing the panes with a removable protective film immediately following their production. This temporary protective film is washed off prior to the respective temperature treatment. Thereafter, another temporary sealing takes place, if required, or the immediate application of the permanent coatings in accordance with the invention.

Tests show that it is possible to create a thermal tempering of panes starting from a thickness of 1.5 mm by strongly blowing cold air against them or dipping them into oil, or oil-covered water, which considerably increases the stability of the large-area radiators. Thermal tempering should take place after cutting the glass panes (for example for fabricating the panes in the size of large-area radiators).

The combination of thermal tempering and coating with ductile polymer layers results in a further increase of stability. Coating must take place after tempering.

The invention will be explained in greater detail in what follows by means of two exemplary embodiments:

Exemplary Embodiment 1

The rear pane of a large-area radiator, which itself is already finished and capable of functioning, is sprayed with a thin coat of a two-component silicon polymer after the last baking process, so that a continuous wetting layer is created. The layer is then polymerized. The amount of silicon polymer is set in such a way that a polymer coating of 40 to 45 μm thickness results.

Exemplary Embodiment 2

A large-area radiator of 320 x 360 mm size is to be provided with a chemically tempered front pane of 1.1 mm thickness. Glass D263 (reference: DESAG AG of Grünenplan) is used for the front pane. 1.1 mm thick panes made of this glass are dipped for 16 h in a hot KNO_3 bath at 450°C in order to temper them by the "Na - K exchange". By means of this, tempering of more than 230 MPa is created in a surface layer to a depth of 80 μm. It was observed that, in the subsequent processes in the course of producing the large-area radiator, a portion of the tempering was "washed out" again, but tempering of more than 200 MPa was observed to be a permanent value.

Claims

1. A large-area radiator with a front pane and a rear element, wherein the front pane is kept apart from the rear element by means of spacer elements, wherein a gaseous filler has been introduced into the space between the front pane and the rear element and is at a lesser pressure than the pressure of the surrounding atmosphere, and wherein the front pane is made of a glass material,

characterized in that

the front pane and/or the rear element are embodied as at least partially thermally or chemically tempered glass panes.

2. The large-area radiator in accordance with claim 1,

characterized in that

the temperature, at which the viscosity of the glass material of the thermally tempered front pane and/or rear element is 13.6 dPas (TG temperature), is greater than 550°C.

3. The large-area radiator in accordance with claim 1 or 2,

characterized in that

the measurement of the wall thickness of the thermally tempered front pane and/or back element is 1.5 mm to 2.1 mm, and/or the thermal tempering is greater than or equal to 60 Mpa.

4. The large-area radiator in accordance with claim 1,

characterized in that

the measurement of the wall thickness of the thermally tempered front pane and/or back element is greater than 0.5 mm, and/or is tempered by means of a chemical tempering of more than 160 MPa.

5. A large-area radiator with a front pane and a rear element, wherein the front pane is kept apart from the rear element by means of spacer elements, wherein a gaseous filler has been introduced into the space between the front pane and the rear element and is at a lesser pressure than the pressure of the surrounding atmosphere, and wherein the front pane is made of a glass material,

characterized in that

the front pane and/or the rear are embodied as glass panes which are at least partially provided with a coating consisting of a ductile polymer material.

6. The large-area radiator in accordance with claim 5,

characterized in that

the coating is embodied as a film and consists of silicon, polyurethane or polymer material, selected from the group of the ormoceres.

7. The large-area radiator in accordance with claim 5 or 6,

characterized in that

the coating has a thickness of more than 6 μm.

8. The large-area radiator in accordance with claim 7,

characterized in that

the thickness of the coating lies within the range of 6 μm and 50 μm.

9. The large-area structure in accordance with one of claims 5 to 8, characterized in that

a primer is used for bonding the coating to the surface of the glass pane, preferably dimethoxydimethyl silane or hexamethyl disilazane.

10. The large-area radiator in accordance with one of claims 5 to 9, characterized in that

the glass pane is at least partially thermally or chemically tempered.

11. The large-area radiator in accordance with one of claims 1 to 10, characterized in that

wavy spacer elements are arranged between the front pane and the rear element, which is also embodied as a glass pane, wherein the wavy line extends parallel with the planar extension of the front pane.

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JC18 Rec'd PCT/PTO 11 JUL 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Roland BÜRKLE
Reinhard KASSNER

Title: FLAT LIGHT SOURCE

Based Upon: PCT/EP00/00147

Express Mail No.: EL688021494US

Date of Deposit: 11 July 2001

LETTER TO DRAFTSPERSON

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please amend the drawings by adding the Figure numbers, as shown in red ink on Figs. 1-5.

Respectfully submitted,

Douglas H. Pauley
Regis. No. 33,295

Pauley Petersen Kinne & Fejer
2800 West Higgins Road, Suite 365
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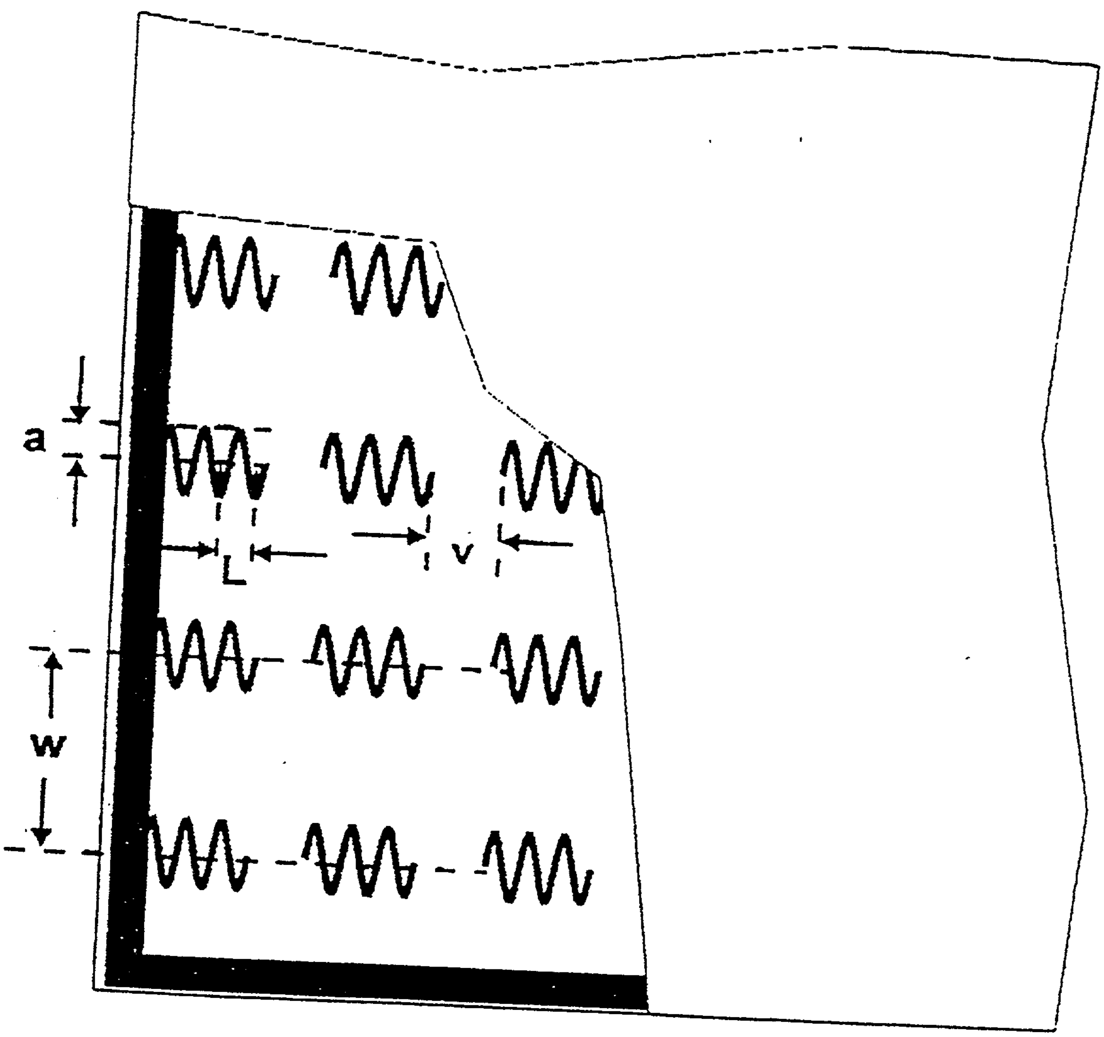

FIG. 5

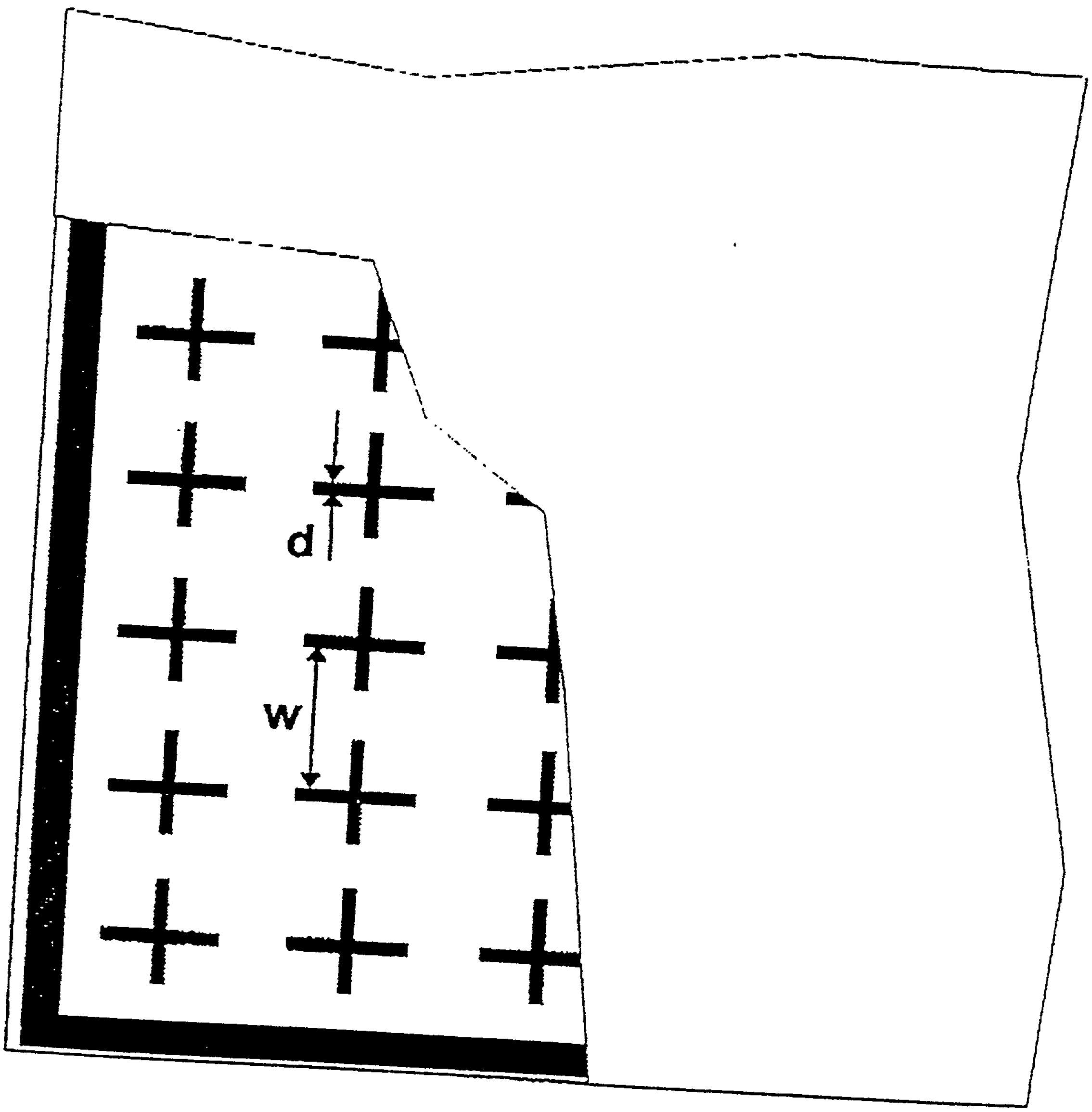

FIG. 4

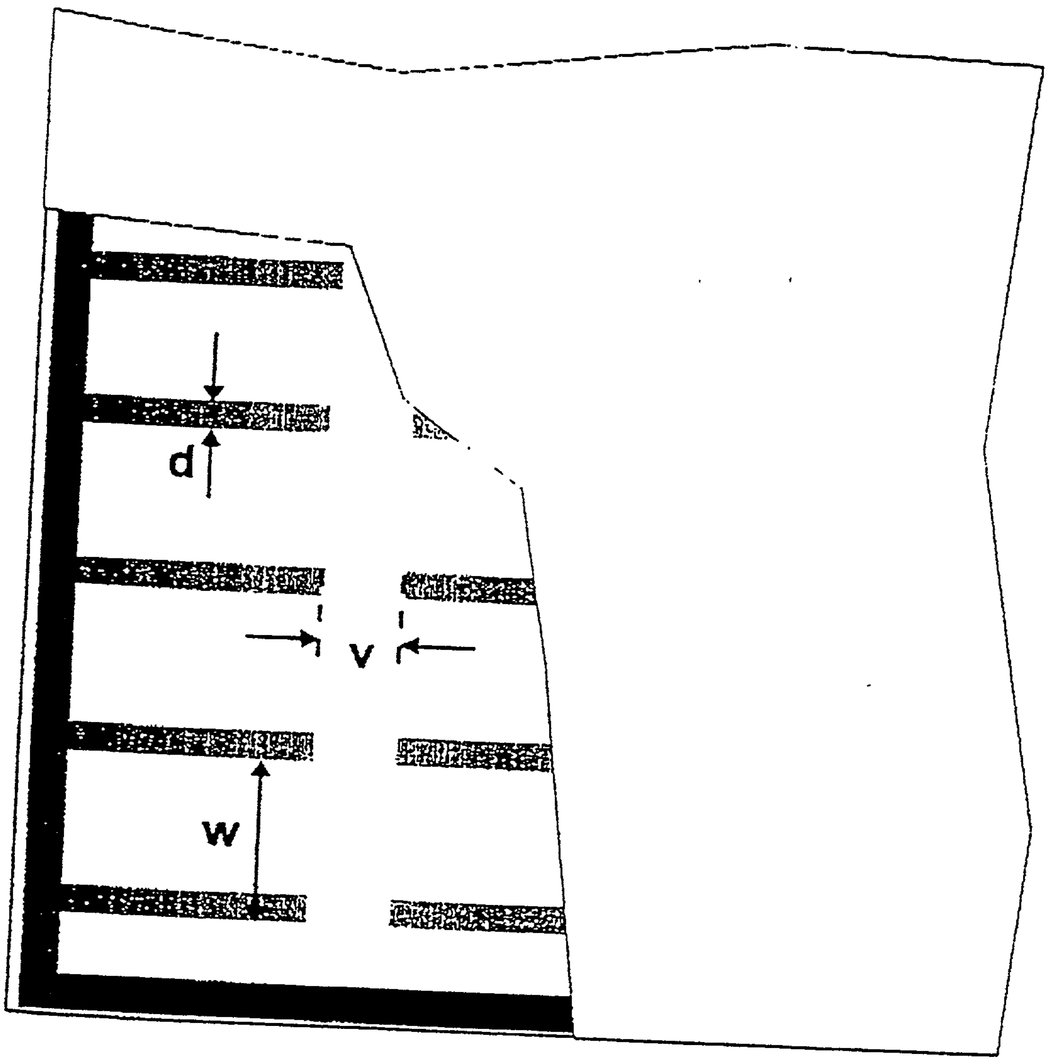

FIG. 3

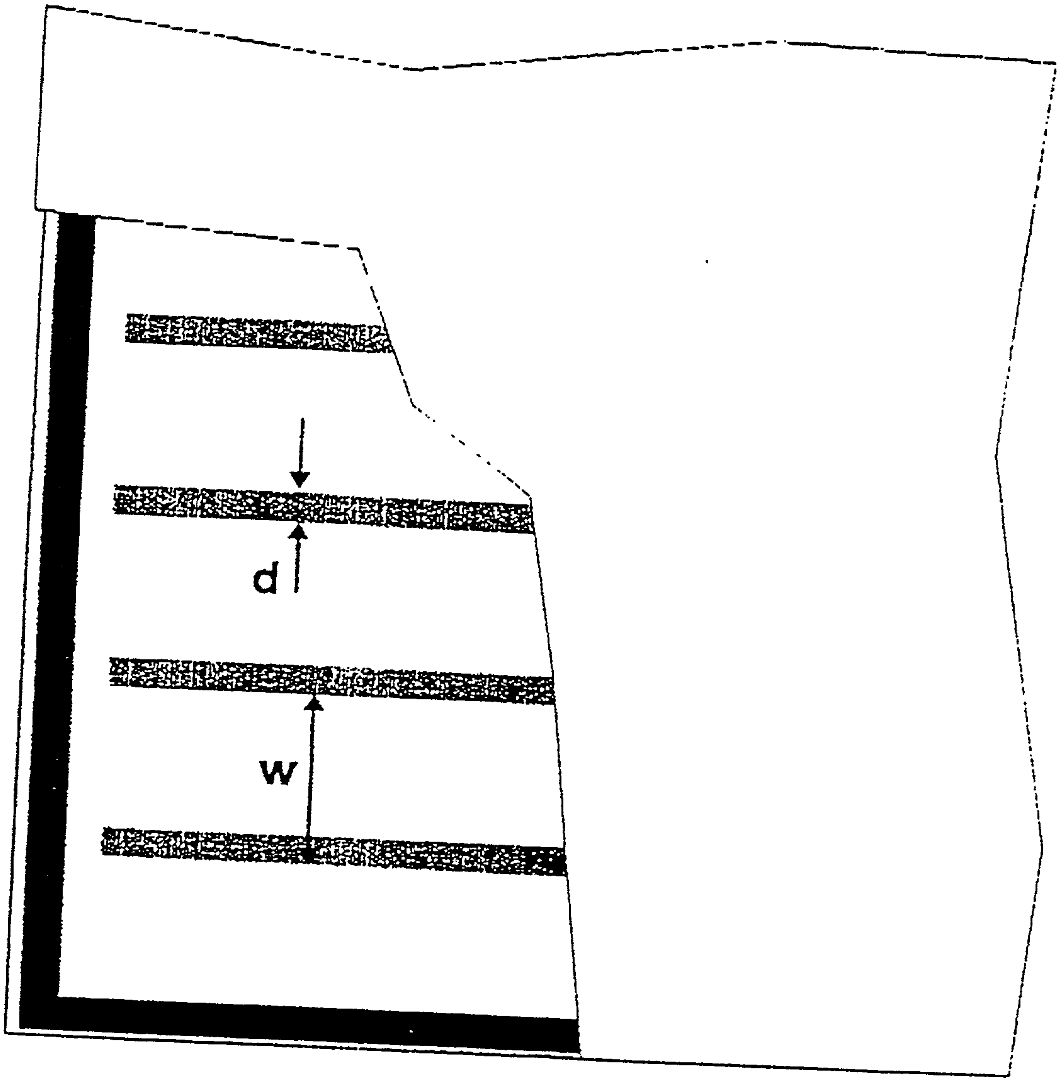

FIG. 2

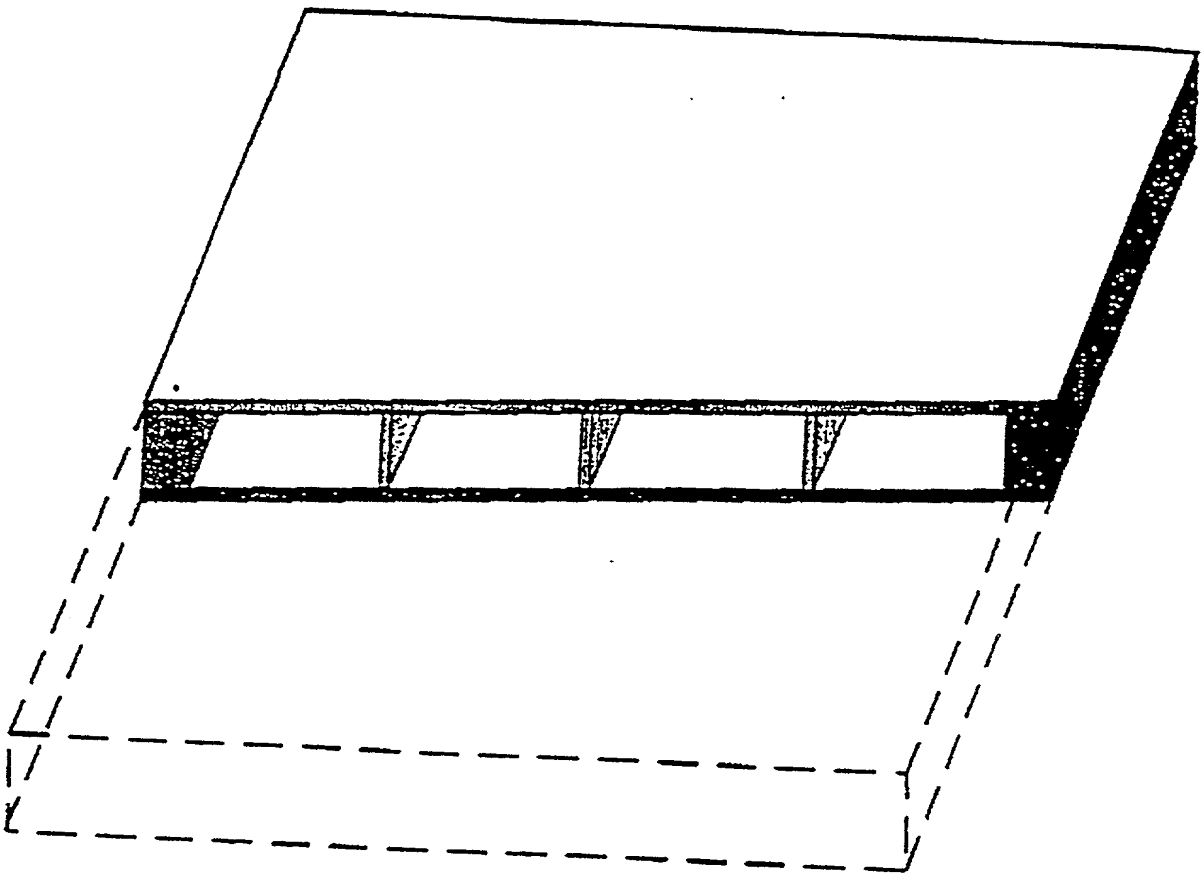

FIG. 1

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterlinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

FLÄCHENSTRAHLER

deren Beschreibung

(zutreffendes ankreuzen)

■ hier beigefügt ist.

☐ am ____________ unter der

Anmeldungsseriennummer ____________

eingereicht wurde und am ____________ abgeändert wurde (falls tatsächlich abgeändert).

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

FLAT LIGHT SOURCE

the specification of which

(check one)

■ is attached hereto.

☐ was filed on ____________ as

Application Serial No. ____________

and was amended on ____________ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

(Number) (Nummer)	(Country) (Land)	(Day/Month/Year Filed) (Tag/Monat/Jahr eingereicht)	Yes Ja	No Nein
199 00 713.6	Germany	11 January 1999	■	☐
PCT/EP00/00147	PCT	11 January 2000	■	☐
			☐	☐

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 112 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT Internationale Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (Anmeldeseriennummer)	(Filing Date) (Anmeldedatum)	(Status) (patentiert, anhangig aufgegeben)	(Status) (patented, pending, abandoned)
None	None	None	
None	None	None	

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent-und Warenzeichenamt: *(Name und Registrationsnummer anführen)*

Thomas W. Speckman Regis. No. 22,617	Douglas H. Pauley Regis. No. 33,295
Maxwell J. Petersen Regis. No. 32,772	Charles C. Kinne Regis. No. 31,631
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Nick C. Kottis Regis. No. 31,974	Roland W. Norris Regis. No. 32,799
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BEVOLLMÄCHTIGUNG DER ANWÄLTE, AUFTRÄGE UND INSTRUKTIONEN VOM VERTRETER DES ANMELDERS ENTGEGENZUNEHMEN UND AUSZUFÜHREN

Der die Erklärung und Vollmacht Unterzeichnende ermächtigt die obengenannten Rechtsanwälte in den USA Weisungen vom Vertreter
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Voller Name des einzigen oder ursprunglichen Erfinders:

Kurt NATTERMANN 3/8/2001
Unterschrift des Erfinders Datum

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following Attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

10

Thomas W. Speckman Regis. No. 22,617	Douglas H. Pauley Regis. No. 33,295
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AUTHORIZATION OF ATTORNEYS TO ACCEPT AND FOLLOW INSTRUCTIONS FROM REPRESENTATIVE

The undersigned to this declaration and power of attorney hereby authorizes the U.S. attorneys named above to accept and follow instructions from
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Jeck • Fleck • Herrmann
Postfach 1469
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Germany
as to any actions to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys will be so notified by the undersigned.

1.00

Full name of sole or first inventor:

Kurt NATTERMANN 3/8/2001
Inventor's Signature Date

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German Language Declaration

2-00

Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor:
Volker SEIBERT	Volker SEIBERT
Unterschrift des Erfinders: Volker Seibert — Datum: 04.09.01	Inventor's signature: Volker Seibert — Date: 09/04/01
Wohnsitz: Ober-Olm, Germany	Residence: Ober-Olm, Germany DEX
Staatsangehorigkeit: Germany	Citizenship: Germany
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3-00

Voller Name des dreiten Miterfinders (falls zutreffend):	Full name of third joint inventor:
Roland BÜRKLE	Roland BÜRKLE
Unterschrift des Erfinders: Roland Bürkle — Datum: 27.08.01	Inventor's signature: Roland Bürkle — Date: 08/27/01 — witness: [illegible]
Wohnsitz: ~~Nieder-Olm~~, Germany Kirchentellinsfurt	Residence: ~~Nieder-Olm~~, Germany Kirchentellinsfurt
Staatsangehorigkeit: Germany	Citizenship: Germany DEX
Postanschrift: Am Eselborn 15, D-55268 Nieder-Olm, Germany — DR. ROLAND BÜRKLE, ~~PETER IMHOFF-STR~~. 51, D-72138 KIRCHENTELLINSFURT, TEL/FAX: 07121/603840, Germany	Post Office Address: Am Eselborn 15, D-55268 Nieder-Olm, Germany — DR. ROLAND BÜRKLE, PETER IMHOFF-STR. 51, D-72138 KIRCHENTELLINSFURT, TEL/FAX: 07121/603840, Germany — Bürkle

4-00

Voller Name des vierten Miterfinders (falls zutreffend):	Full name of fourth joint inventor:
Reinhard KASSNER	Reinhard KASSNER
Unterschrift des Erfinders: Reinhard Kassner — Datum: 05.09.01	Inventor's signature: Reinhard Kassner — Date: 09/05/01
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